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ABSTRACT

Designed to assist educators in planning for the use of microcomputers in their schools, this guide begins with a brief statement of a philosophy for the use of computers in education. The main positions expressed by this philosophy are that students must have the opportunity to learn about the role of technology in society and to acquire the knowledge and skills necessary to use the computer as a personal tool for learning, and that educators should use the computer to augment classroom instruction, to manage instruction more effectively, and to make possible the development of new curricula as well as new approaches to learning. An overview of educational uses of computers is provided and the Division of Instructional Media and Technology is briefly described. Minimum objectives and curricular models for computer literacy for students in Virginia are then presented, followed by guidelines for reviewing and selecting hardware and software. Objectives and suggestions for staff development programs are also provided for three levels of competencies: basic computer literacy, utilization of computers in instruction, and specialization in computer education. A list of available videotapes on computer literacy and the use of microcomputers in the schools for use in connection with staff development activities concludes the guide. (MES)

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guidelines FOR educational computing IN virginia

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MESSAGE FROM THE SUPERINTENDENT OF PUBLIC INSTRUCTION

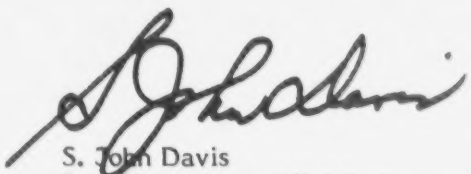
The decade of the 1980s is both a challenging and exciting time to be involved in education. Much of this excitement has been generated by technological advances. With these advances occurring at an unprecedented rate, school systems are facing major decisions on how to utilize new technology, particularly microcomputers, for their instructional programs and administrative applications.

This publication expresses a philosophy regarding the use of computers in education. The main positions are that students must have the opportunity to learn about the role of technology in society and to acquire the knowledge and skills necessary to use the computer as a personal tool for learning. In addition, educators should employ the computer to augment classroom instruction, to manage instruction more effectively, and to make possible the development of new curricula as well as new approaches to learning.

Also included are an overview of the educational uses of computers and recommendations concerning instructional activities which Department of Education officials believe represent a responsible approach to the development of computer programs.

The publication also includes resources to assist with program development. Among these resources are the services of the Utilization and Evaluation staff, Division of Instructional Media and Technology, guidelines for implementing computer literacy programs, suggestions to assist in the selection of computer hardware and software, and a recommended staff development model for educational computing.

It is hoped that this guide will help educators and students meet a major challenge of the 1980s.



S. John Davis
Superintendent of Public Instruction

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INTRODUCTION

Many troubling decisions face educators as they plan for the use of microcomputers in their schools: What are the ways computers could be used in the educational program? What should be taught, and at what grades? Who should do the teaching? What software is most suitable? Which, and how many, microcomputers should be purchased? And, where should they be located? This publication, developed by the **Division of Instructional Media and Technology** of the Department of Education, with valuable help from representatives from higher education and local school divisions, is provided to assist educators in making those decisions.

The sections which follow cover a range of topics which are critical to establishing a program in instructional computing. There are guidelines for developing a division computer plan; definitions and descriptions of the major educational uses of microcomputers; recommendations for priorities in implementing educational computing; objectives for computer literacy for students, with descriptions of common curricular approaches; guidelines for the review and selection of software and hardware; and outlines of computer literacy objectives for teachers with suggestions for staff development programs.

This publication is intended to serve as a guide, not as a directive. Educators should use these guidelines and recommendations to assist them in arriving at decisions which are most appropriate for their school divisions.

PHILOSOPHY

There is a dual need for schools to use technology in education. Schools have the responsibility to prepare students to function in the society in which they live. Today, this means that students must have an opportunity to learn about the role of technology in that society. Schools also have a responsibility to continually seek effective means to improve learning. Both of these responsibilities are best served when educators view technology as a tool to enhance instruction, rather than a body of knowledge to be learned.

The effectiveness of technology in improving learning depends upon the ways in which it is used, not upon any particular technology itself. Educators should strive to match appropriate technologies to particular instructional tasks in all curriculum areas to help them to do better those things which have always been done, and to enable them to undertake tasks which previously had not been feasible.

In the same way, the microcomputer should now take its place as part of instructional technology. Educators must provide appropriate opportunities for all students to develop minimum computer knowledge and skills. Beyond that, educators should employ the microcomputer in the day-to-day business of schooling to augment classroom instruction; to better manage instruction; to make possible new curriculum and new approaches to learning; and, to allow students to use the computer as a personal tool for learning. In this way the school will develop students who are truly "computer literate."

DIVISION OF INSTRUCTIONAL MEDIA AND TECHNOLOGY

The **Division of Instructional Media and Technology** was formed July 15, 1982, bringing existing media services together in the same division and accommodating the growing need to provide services in the area of instructional computing. The DIMT provides leadership, coordination, and technical assistance to school divisions in the acquisition and use of the major instructional technologies, including textbooks and other print media, audiovisual media, instructional television, and microcomputers. The reorganization was completed in February of 1983 with the appointment of associate directors to head the division's two services.

DEVELOPMENT AND DISSEMINATION

This service is responsible for the acquisition of films and instructional television programs; the operation of the videotape duplication services and film loan service, including the regional film libraries at Longwood College, Radford University and the University of Virginia; materials production, including transparencies, film and instructional television; and coordination of program selection for the State ITV contract through the Regional School Contract Planning Committees.

UTILIZATION AND EVALUATION

This service administers the State Textbook Adoption Program and provides consultative services to school divisions regarding library media programs and the application of technology to instruction. Such services include on-site visitation, review and evaluation, assistance in local planning, and assistance in the development and presentation of in-service programs. The areas of instructional technology in which the service offers consultation include school libraries and information retrieval systems, audio-visual instruction, instructional television and interactive video, and the various aspects of educational computing.

This service also manages the Technology Examination Center (TEC) and the Virginia Network for Educational Technology (VNET), an online message and database service accessible to school divisions.

VNET

The Virginia Network for Educational Technology (VNET) is an online electronic mail, bulletin board, and database system established in 1984. VNET is provided by the Division of Instructional Media and Technology as an additional channel of communications to promote the exchange of information across the state. All public education institutions may use the network.

The electronic mail component of VNET can be used to send private communications. Electronic mail is fully addressable by using the receiver's school division code and can only be read by the receiver(s) designated by the sender. The bulletin board feature of VNET can be used to post general announcements and queries pertaining to instructional technology which can be read by all users of the system.

Another component of VNET is the software evaluation database (SED). Abstracts of MicroSIFT evaluations and evaluations from educational agencies may be searched "online" at the local level. Educational agencies also may enter evaluations directly into the VNET database and are encouraged to do so.

Access to VNET is available by using a password assigned to the user by the Division of Instructional Media and Technology. To obtain a password, educators should contact the Division. Equipment necessary to use VNET consists of a microcomputer and telephone modem with appropriate telecommunications software, and an available telephone line. A printer also is useful to produce a "hardcopy" of the electronic message. Regularly using VNET has proved to be an effective means for educators to disseminate and receive the most current information on instructional technology. A user's manual for VNET is available from the Division of Instructional Media and Technology.

TEC

The Technology Examination Center (TEC) has been established to provide a setting where educators can examine a variety of microcomputer software and hardware. The center also serves as a training center and information clearinghouse.

In the center, a collection of purchased software and courseware is available for hands-on review. This collection is continually updated; suggestions from the Department of Education and school divisions are considered for inclusion. All Minnesota Educational Computing Consortium (MECC) software has been acquired for examination. In addition to purchased items, computer programs and other materials are placed in the center on temporary loan by vendors and publishers.

The various makes and models of microcomputers commonly used in educational settings are on display in the TEC. The center also houses an assortment of peripheral devices, including monitors, disk and tape drives, printers, graphics tablets, voice and music synthesizers, and telephone modems. Educators visiting the center have the opportunity to observe, and obtain hands-on practice with a variety of hardware options and configurations.

In order to function as a clearinghouse for information relating to instructional technology, the TEC maintains a varied collection of resources. Software reviews and evaluations from MicroSIFT are on file, and may be photocopied. Reviews and evaluations of both hardware and software published by EPIE, the Educational Products Information Exchange, are also on file.

Other resources found in the center include software and hardware directories as well as current and back issues of more than a dozen periodicals on educational computing and the computer industry. The most current information on products, applications, and trends are found in these publications.

Sample textbooks and audiovisual materials which can be used in computer-related courses are available for examination in the TEC. The center also houses a collection of video programs, with topics ranging from computer awareness to training in the use of specific software. These include materials suitable for staff development as well as classroom use. The state has purchased duplication rights to most of these video programs, which can be copied in the VHS, BETA I, and U-Matic videocassette formats on tapes supplied by the requesting school division; previewing is recommended prior to requesting copies.

The TEC can serve as a resource in several ways: individuals may use instructional diskettes or videotapes for personal in-service training to fit their individual needs and schedules; an individual or small group may visit the center to examine hardware configurations and software packages; a selection committee may schedule a trip to the TEC specifically to examine software. Classes also are conducted by the Center to meet the continuing needs of the DOE staff. Topics include programming, electronic spreadsheets, word processing, database management, teacher utilities, and courseware utilization. These classes are open to educators outside the department when space is available.

The Technology Examination Center is located on the 18th floor of the James Monroe Building, 14th and Franklin Streets. The center is open between 8:00 a.m. and 5:00 p.m., Monday through Friday, except state holidays. Persons wishing to use the hardware and software in the center are encouraged to call in advance for an appointment.

PLANNING FOR INSTRUCTIONAL COMPUTING

The successful implementation of an instructional computing program requires a comprehensive and systematic plan based on local needs, goals, and objectives. It is essential that a division plan be developed prior to any significant purchase of microcomputer hardware or software.

The cost of computer hardware and software is such that programs which meet even basic needs will, most likely, have to be implemented in phases over a period of several years. At the same time, needs will probably change and experience will suggest additional areas of computer utilization. As educators plan for current needs and usage, they should anticipate future needs as well. However, due to rapid technological changes, long-range planning is difficult, if not counterproductive. The point is, that the school plan should provide some sense of direction so that decisions made now will serve as a foundation for the near future. In this way, new programs and purchases will more likely complement existing ones, and premature obsolescence will be avoided.

The following paragraphs suggest both a process to follow and factors to consider when developing a local plan for instructional computing.

PLANNING COMMITTEE

Form a planning committee to develop a comprehensive educational computing plan that ensures that technology follows instruction, rather than the other way around. The committee should be composed of persons who represent the various educational constituencies within the school division:

- Central staff supervisors and administrators;
- Curriculum specialists;
- Principals, elementary, middle, and secondary;
- Teachers, representing various grades and disciplines;
- Instructional computing specialists, if available; and,
- Parent representatives.

After the committee is organized, the next step is to provide staff development for its members. Planners need to become aware of the general capabilities of microcomputers, especially ways in which they can be used for instruction. They also need to become familiar with the various popular microcomputers and the kinds of software available for each; and, most importantly, they must understand the curriculum issues involved as well as the options which are available for instruction.

The preliminary in-service training can be accomplished in a variety of ways, including workshops, viewing videotapes, reading popular journals on educational computing, reviewing the plans and curriculum guides of other school divisions, and visiting other schools and the Department's Technology Examination Center in Richmond. The utilization staff of the Division of Instructional Media and Technology is available to identify resources and assist in planning this effort.

PLANNING PROCESS

There is no "correct" way to carry out the planning process. As needs vary among localities, so, too, will the planning process and the final plan. Still, a general planning guide is useful and the following list identifies the major tasks, in approximate order, facing the planning committee:

- Develop a statement of philosophy and goals. This serves as the basis for deliberation and decision.

- Assess needs and interests. What are the needs of students at various grade levels? What are the expectations and special needs of the school community? What do teachers want and hope to accomplish?

- Develop preliminary curriculum. A detailed computer curriculum is not necessary at this point, but some outline of curriculum goals, scope and sequence, course offerings, and possible organizational approaches is needed to guide decisions on software, hardware, and delivery strategies.

- Review courseware. Again, software selections do not have to be made at this juncture, but a broad review of software, in relation to the curriculum goals and the various microcomputers under consideration, must be conducted; this should include texts, workbooks, and other print materials, as well as audiovisual and video resources. The review, evaluation, and acquisition of software is an on-going process; however, the committee's work should include divisionwide guidelines for this process.

- Review hardware. The committee now is in a position to conduct research and review available hardware - microcomputers, peripherals, and accessories - which will best serve the curriculum within the available budget.

- Plan staff development. This is a plan unto itself, with its own needs assessment, curriculum development, and implementation strategies; however, a general staff development plan is also the responsibility of the committee.

These are the major tasks which face the School Division Computer Education Committee. How the committee carries out its responsibilities can vary widely, and is, of course, subject to local policies and procedures.

PLAN COMPONENTS

Although most of the components of a computer education plan are implied in the preceeding guidelines, the plan should include:

- A statement of philosophy.

- Instructional goals, objectives, and strategies.
- Recommendations for instructional organization and delivery strategies.
- An outline of general courseware needs, and recommendations for initial software purchases.
- Recommendations for the makes and models of microcomputers, peripherals, and accessories; the number to be purchased; and the method for placing them in the schools.
- Guidelines for the management, maintenance, and replacement of software and hardware.
- An outline for a division staff development program.
- A projected budget and timetable for implementation.

The subsequent chapters in this publication deal with the factors to consider in each of these major areas, and should serve as a valuable resource to local planning groups.

EDUCATIONAL USES OF COMPUTERS

The computer is a general purpose machine and there are many ways in which it can be used effectively by educators. Moreover, the advent of the microcomputer has made it not only possible but practical to put computing power in the hands of administrators, teachers, and students alike. Any comprehensive plan using computers in educational programs must address all applications that are appropriate for the school setting.

Many routine management tasks can be handled at the building level by using any of several popular brands of microcomputers, supported by various generic software products and specific school applications packages. However, the emphasis in this publication is on instructional uses of the computer, so no attempt is made to detail the ways a microcomputer might be used in school administration.

This section focuses on educational uses of microcomputers which have a direct impact on the instructional program of a school, and offers suggestions for program development. While distinctions are not always clear, instructional computing relates to two types of programs: (a) those in which the computer is the object of instruction, and (b) those in which the computer supports instruction.

Much has been written regarding the relative merits and importance of these instructional applications, yet educators have reached no consensus on the subject. One problem is the difference in interpreting and understanding terminology. The following definitions and descriptions can provide a frame of reference for Virginia educators in communicating and sharing ideas, and in improving the planning and coordination of instructional programs.

INSTRUCTION ABOUT COMPUTERS

Programs in this area focus on the computer as the object of instruction. Students learn, at varying levels of complexity, what computers are, what they can do, how they are operated, how they are programmed, and when and how they should be used to solve various problems.

Such programs usually fall into one of the following categories:

Computer Literacy

This category includes those instructional efforts aimed at developing in students a minimum, functional understanding of computers. Diverse curricular approaches can be used. Computer literacy is generally seen as a "modern" basic skill, and is a goal for all students.

As this is being written, computer literacy is a subject of great concern. Accordingly, this facet of computer instruction, as it pertains to Virginia schools, will be discussed more fully in the following chapter.

Computer Science

This is the usual designation for courses which provide in-depth study of the computer, generally in the context of mathematics or physical science. Schools which offer computer science do so as an accommodation to students with the ability and interest to pursue this more advanced study.

Computer science courses may vary from school to school, but they typically have a strong programming component, with BASIC being the language most frequently used. In an effort to establish a uniform curriculum for computer science, the Board of Education has approved two courses, which may be used to meet the mathematics requirement for graduation:

1. Computer Mathematics (#3184) - In this course the computer is used to solve problems by applying mathematical models. Programming is included in the course, with concentration in one language. The BASIC language is suitable for this course, although other languages can be introduced.

2. AP Computer Science (#3185) - This course is designed to provide college-level computer science in high school. Students successfully completing the course should be eligible for advanced placement. The course will emphasize programming methodology, algorithms, and data types and structure. Pascal will be the programming language.

Computer Applications

This designation applies to courses which provide extensive study of computer use, with appropriate software, to accomplish routine tasks, primarily in a business environment. The courses are usually offered in high school business education programs.

Although programming may be a component of such courses, the emphasis is on the study of generic applications software packages and on their skillful use in performing business functions. Wordprocessors, database managers, and electronic spreadsheets are representative of the applications software studied.

Again, to help standardize the computer-related curriculum, the Board of Education has approved two courses as part of the business education program:

1. Computer Concepts (#6611) - Computer Concepts is a half-year course suggested for the tenth, eleventh and twelfth grades. The course introduces data processing and examines the evolution of computing equipment. Topics include growth of data processing systems, applications of data processing, the basic data processing cycle, data representation, equipment and systems, and an introduction to computer programming using the BASIC language. The course provides an opportunity to examine careers in data processing.

2. Business Computer Applications (#6612) - Business Computer Applications is a one-year course that includes introduction to data processing, computer programming using the BASIC language, and the use of accounting software, wordprocessors, database managers, and electronic spreadsheets. Suggested grades for this course are 11 and 12. The microcomputer is used as the primary instructional tool.

Also included in this overall category are vocational data processing courses and studies of appropriate computer applications in other vocational courses.

INSTRUCTION USING COMPUTERS

This type of educational computing will probably reach the greatest number of students and have the greatest impact on the overall instructional program. Here, the computer is used to enhance or enrich instruction in all disciplines and at all grade levels. A broad range of applications fall into this category.

Computer-Assisted Instruction

Usually identified simply as "CAI," this process involves using the computer, supported with appropriate software (sometimes called courseware), to perform certain instructional functions. Several variations of CAI software are recognized:

Drill and Practice

This type of software provides activities to reinforce or practice concepts and skills already taught or learned. Various design features can heighten the students' motivation to engage in computerized drill and practice activities. High quality programs typically allow for the varying abilities of students; provide students with immediate results of performance; include options for further help or reteaching; and tabulate and file performance results for each student. Many packages even allow the teacher to modify the program to tailor it to class needs.

Tutorials

Tutorial programs present new concepts or skills by means of examples and questions that check for students' understanding. The key feature is the interactive property of the software, in which the program branches in accordance with student response. Good tutorial programs will enhance learning by means of clear, consistent presentation, as well as the use of graphics, animation, and sound. They will accommodate students' varying abilities or entry-level knowledge, and they often have a record-keeping feature. Tutorials are useful for additional instruction or for supplemental instruction beyond the usual scope of textbooks.

Simulations

Programs in this category present models of complex situations or processes. Simulations make particularly good use of the interactive capabilities of the computer. Under the control of the program, student decisions are factored with other variables to produce imitations of real-life phenomena. The benefit of simulations is that they permit instruction which may be too complex, too time-consuming, too expensive, or too dangerous to be offered in other ways - in short, they present concepts which could not, or would not, otherwise be presented.

Games

Instructional games are essentially drill-type programs which employ "arcade" graphics and elements of competition to add excitement and motivation. Most students find these games an enjoyable way to practice various skills and to test knowledge. A point to remember, however, is that a student's performance is dependent not only on his knowledge but on his ability to manipulate the computer; scores, therefore, are not always an accurate indicator of student achievement.

Most teachers generally use CAI to augment regular instruction. But, CAI also can refer to computer-based instruction (CBI) in which the computer becomes the primary, if not the only, means of instruction. In CBI, the computer is used extensively to present instructional experiences (essentially, all of them), to track student progress, and to adjust the presentation to particular student needs. In a properly designed CBI system, adjustments would be made for each student independently.

Computer-based instruction requires extensive courseware and hardware, both of which are expensive. However, when CBI is used in low-enrollment courses, or offers instruction otherwise impossible to provide, or frees teachers to provide other instruction, its costs might be justified.

To summarize, the value of CAI derives from the quality of the courseware and the interactive capabilities of the computer. The microcomputer is a self-contained unit, easily controlled by the teacher, which has the capability to help individualize instruction, to provide immediate feedback and reinforcement, and to permit instructional experiences not possible without a computer.

Computer-Managed Instruction

This area, referred to as "CMI," includes the various uses of the microcomputer in planning, preparing, monitoring, and analyzing instruction. CMI has the potential to facilitate instruction with a relatively small investment.

Record Management

Teachers can use a variety of programs to manage student files and classroom inventories, to score tests and record grades, and to track student progress and prescribe instruction.

Materials Production

Teachers can use various types of software, from general word processors to specialized test or puzzle "generators," to produce instructional materials. Such materials could include worksheets, study guides, quizzes and tests, and even word-find and crossword puzzles.

In a well-developed CMI system, a teacher could create classroom paper-and-pencil activities; follow instruction with a test keyed to specific objectives; automatically score the test and record the grades; perform an item-analysis of the test to identify individual weaknesses; and prescribe subsequent instruction for each student - all with a microcomputer and readily available software.

Instructional Computer Applications

This category refers to the use of the microcomputer as a tool to expedite and facilitate instructional tasks rather than as a means of presenting subject matter per se. In using applications software for word processing, spreadsheet manipulation, database management, and online data retrieval, the computer is used to reduce the tedious aspects of an assignment, freeing the student to concentrate more on the concept or skill being learned.

Word Processing

Word processing enables students to focus on ideas and creativity by facilitating the tasks of editing, revising, and correcting. This computer application not only enhances the teaching of writing but also is useful to students in completing written assignments in any subject.

Database Management

Database management programs can be used with any subject requiring a student to compile and analyze categorical information: the taxonomy of plants, the platforms and performance of presidential candidates, bibliographic information, and critiques of books read during a school year.

Electronic Spreadsheet Manipulation

Electronic spreadsheet programs facilitate the manipulation of tabular data, and can assist students with any assignment in which such data is involved. Whether students are studying home budgeting or international trade deficits, or collecting data for a science experiment, the spreadsheet application allows them to make more observations, to accept more data, to analyze more variables, and in doing so, to understand more fully the concept being presented.

Problem Solving

In most of its applications the microcomputer is a problem-solving tool; however, in many instructional situations the microcomputer can be used with particular problem-solving software. Such software usually serves as a utility into which variable data is entered, and the program performs complex and time-consuming calculations. For example, a class in electronics might use a particular program to calculate the values of resistors needed in a circuit, based upon the values for other components in the circuit which the student would provide, or in a physics class, the computer might use a theoretically derived formula to predict the travel of a ballistic object, which the student would confirm with experimental observation.

The microcomputer can also be used with specific software that will allow its interface with instruments that can record, control, and analyze physical occurrences.

Graphics and Sound

Problem solving in music, art, or graphic design can be supported with the microcomputer. A variety of software is available to assist with music composition, and there are peripheral devices which simulate certain instruments, e.g., a keyboard for piano or organ practice, and a three-value device for practicing note-fingering on the trumpet.

Students using graphics tablets, light pens, and even joysticks, can create remarkable sketches and other designs. Graphics utility software will permit the representation of data in a variety of graphic forms quickly and easily.

Online Data Retrieval

Online retrieval services offer convenient and timely access to information through the use of a microcomputer and telephone modem. Using such systems, students come to understand techniques for searching central databases electronically, combining pertinent terms or concepts in ways not possible with manual search methods. The result is the efficient retrieval of information with exceptional precision and relevance to assignments in any subject.

RECOMMENDATIONS

When computer-related activities are being considered for a school, the first concern should be the best allocation of school resources. Clearly, the school plan must include priorities for computer use that best serve the needs and resources of the locality.

The following list of program components is offered as a guide. These recommendations provide scope and sequence in instructional computing activities which the Department of Education believes represent a responsible approach to program development.

- School divisions should initiate instructional activities which will give all students the opportunity to achieve, by the time they graduate from high school, the objectives outlined in Computer Literacy for Students in Virginia.

- In all general education curricular areas and in all grades, the school should use the microcomputer as an instructional problem-solving tool to be applied, for example, in information storage and retrieval, word processing, graphics and sound generation, simulations, and the control and analysis of physical phenomena.

- All high schools should provide a computer science program for interested and able students.

- One or more courses emphasizing business computer applications should be available at the high school level for all interested and able students.

- Computer applications should be integrated into all vocational programs where appropriate; this should include the availability of a vocational data processing program.

- All schools should use microcomputers to help manage instructional programs, including diagnosis and prescription, and to monitor student progress, as well as teacher-support functions, such as producing tests and instructional materials, and grading and record keeping.

- Computers should be used in general building-level administration, such as scheduling, attendance, pupil records, inventories, and general accounts.

- Computer assisted instruction should be used to augment instruction in all grades and subjects for which appropriate courseware is available.

- Online information services should be provided in the school media center to teach information-retrieval skills and for student and teacher use to support instruction.

Few school divisions in the Commonwealth would be able to implement all of these recommendations at the same time; program components will have to be phased in over several years. On the other hand, gearing up for one function can provide, in certain instances, the means for implementing other functions as well. The decision concerning the recommendations to be adopted must be made by each school division.

COMPUTER LITERACY FOR STUDENTS IN VIRGINIA

Few educators would disagree that the school has a responsibility to see that each student has the opportunity to acquire some degree of computer awareness and computer skill, to develop what has come to be known as computer literacy. As the repercussions of the microprocessor explosion are not yet clearly understood, educators are seeking answers to fundamental questions: What is computer literacy? What concepts and skills do students need? And, what are appropriate instructional strategies?

To address these concerns, the Division of Instructional Media and Technology organized a task force on computer literacy made up of key instructional leaders from across the state and members of the Division staff. The charge of the task force was to develop a definition of computer literacy and a set of minimum objectives upon which all Virginia school divisions could plan and implement instructional programs.

The task force heard the comments, opinions, and recommendations of over a dozen presenters regarding what, from their points-of-view, constituted computer literacy and what Virginia schools should be doing to develop it. The presenters represented diverse interests, including the U.S. Department of Education, state colleges and universities, local school boards, school administrators, teachers and, business and industry. The task force used this information to reach a consensus on a preliminary definition of computer literacy and appropriate minimum objectives.

This preliminary draft was circulated to all school divisions with an invitation for suggested changes or other comments. When all responses had been received, the definition and objectives were edited to reflect the recommendations of the localities. This final version is what follows.

DEFINITION

Computer literacy is the ability to understand the capabilities, applications, and implications of computer technology and to use this knowledge to function in society.

MINIMUM OBJECTIVES

The following objectives provide a framework for developing computer literacy. They represent the competencies which students should achieve by graduation from high school. No specific grade level or curriculum placement is indicated to allow each school flexibility in developing its own curriculum.

1. **The student will define selected computer terminology.**
   Descriptive Statement: Such terminology will include the proper names of computer components and terms which indicate procedures and functions, e.g., byte, menu, load, interface, RAM, ROM.

2. **The student will identify the basic components of a computer and describe the function of each.**
   Descriptive Statement: Emphasis will be on the functional component systems, e.g., central processing unit, input/output devices, memory.

3. **The student will load and run a prepared program.**
   Descriptive Statement: Skills emphasized are turning on the computer and appropriate peripherals, inserting the appropriate software and following instructions to complete the program.

4. **The student will use the keyboard to interact with the computer.**
   Descriptive Statement: These skills will include the use of special function and alphanumeric keys.

5. **The student will select and use an appropriate program to accomplish a given task.**
   Descriptive Statement: This involves task analysis, selection and use of compatible software packages.

6. **The student will describe a computer program.**
   Descriptive Statement: Emphasis will be on understanding that a program is a series of logical, sequential statements which instruct the computer to perform the operations necessary to solve a problem or complete a task.

7. **The student will analyze a simple problem and describe procedures to solve that problem.**
   Descriptive Statement: Emphasis is on the use of logical thinking and problem-solving skills. This does not require, but may include the use of a computer and the writing of a simple program.

8. **The student will describe the recent development of computer technology and its applications in daily living.**
   Descriptive Statement: Emphasis will be on computer applications in the home, school and community. This may include the history of computer technology.

9. **The student will describe the potential and limitations of the computer.**
   Descriptive Statement: Emphasis will be on understanding the current and possible future capabilities of computers.

10. **The student will identify and evaluate major ethical, social and economic issues which relate to the use of computers.**
    Descriptive Statement: Emphasis will be on the broad influence of computers upon the many facets of society and resultant changes in patterns of thought and action.

11. **The student will explore computer-related careers and recognize the value of computer skills for future education and employment.**
    Descriptive Statement: Emphasis will be on the future use of computers in a variety of occupations and prerequisite skills needed for career planning.

12. **The student will describe electronic databases as information sources.**
    Descriptive Statement: Emphasis is on information found in databases and methods of information retrieval.

In developing these objectives, the Department of Education was guided by the consideration that any statewide standard should be based on what students must know as they enter our contemporary society.

ACCREDITATION

In July 1983, the Board of Education included the following statement in the accreditation standards for the local schools:

> By graduation each student shall be provided educational experiences directed toward objectives outlined in **COMPUTER LITERACY FOR STUDENTS IN VIRGINIA** issued by the Department of Education.

By not specifying a particular course or grade level for computer literacy, the Board of Education affirmed the belief of the task force and the Department of Education that each school division should have the flexibility to determine which curricular approach to computer literacy is most suitable for its locality.

CURRICULAR MODELS

Throughout the state a variety of curricular approaches are used to address the computer literacy objectives for students. Differences are more those of detail than of substance, so that most plans fit one of the following models:

Computer Literacy Course

In this model, computer literacy is offered as a stand-alone course of the same or similar name and is usually taught by a designated computer literacy instructor. Courses vary in length from six weeks to a full semester. While the one semester course may be an elective, the six to nine weeks courses usually are intended for all students and form one block of a year-long "exploratory" program. This approach is used frequently by school divisions which have a middle school organization that includes an exploratory track.

Computer Literacy Unit

Using this approach, computer literacy becomes a focused study within the context of another subject, typically math, and is taught by the subject teacher during the time period for that subject class. The duration of the unit may vary from five days to as long as nine weeks, with the average being around three weeks. The unit model is widely used, especially in the middle school and upper elementary grades.

Integrated Approach

With this model, the computer literacy objectives are addressed within the context of the most appropriate subject areas. For example, the economic and ethical impact of computers would be dealt with in social studies; their developmental history and potential would be taught during science. This approach is usually encountered in the elementary grades.

CONCLUSION

Finally, the definition and objectives stated above must be viewed for what they are, a starting point. Schools may add to them as the interests of their students and the expectations of their communities dictate. Also the definition of computer literacy will evolve as all educators gain experience in this dynamic field. As the microcomputer becomes even more pervasive in society, and especially in the home, students will almost spontaneously acquire what now suffices as computer literacy; and the expectations placed on the school will be quite different. As educators plan computer literacy programs they might be well advised to consider any curriculum and grade placement as transitory.

SELECTING HARDWARE

In selecting computer hardware, the most important question to be considered is: How will the microcomputer be used? It is the curriculum to be implemented and the utilization to be made of the computers which ultimately determine the capabilities, placement, and number of computers needed in each school.

The following paragraphs review the major factors to consider in the selection of hardware for use in schools. School divisions should use these recommendations to assist them in arriving at decisions which are most appropriate for their situations.

GENERAL FACTORS

For school divisions planning to teach only minimum computer literacy objectives, virtually any microcomputer can be used, including comparatively inexpensive units in the range of $75 to $100 each. However, while computer literacy may be the primary focus of current instructional computing plans, a comprehensive plan for educational computing should anticipate additional use by students and teachers for computer-assisted instruction (CAI), programming, and word processing. These uses may influence the decisions relating to the choice of hardware. Accordingly, one also should review the full range of software available for any computer being considered.

Reliability and maintenance costs are important factors; the performance record of any computer being considered should be reviewed. Sources of data, in addition to the vendor, are journals, user groups, and, most importantly, other schools using the same hardware. It may be wise to consider purchasing only those models which have stood some test of time in the marketplace. In this regard, the assurance of a reputable vendor, with whom the school has had favorable experience, might reduce the risk. Regardless, buying from an established vendor, who is able to provide adequate service, is a wise practice.

If inexpensive, minimal capacity computers are selected, they probably should be treated as "consumables" rather than as capital outlay. For instance, it is not cost-effective to pay $40-an-hour for labor to repair an $88 computer. Neither would it be cost-effective to upgrade this type of equipment to perform the functions of computer-assisted instruction. This type of unit should be used to perform the job for which it was purchased, and simply discarded when worn out.

With these general considerations in mind, more specific factors pertaining to the selection of particular hardware components may be examined.

MEMORY

The memory capacity of even the smallest microcomputer is probably sufficient to be used to teach minimal computer literacy. However, in light of the current level of computer

development, it is recommended that any model selected have at least 64K RAM. Microcomputers with larger RAM, e.g., 128K, are available and support more sophisticated CAI software. If and when such software is deemed necessary, the larger capacity machines would be required. Conversely, when a microcomputer is being selected for a dedicated purpose, e.g., introductory programming, or cartridge-based LOGO, a machine with a smaller RAM might be justified, if a significant amount of money could be saved.

KEYBOARD

A keyboard with articulated keys which conform to standard typewriter configuration and individual key size is recommended. Special function keys should be conveniently located but positioned so as to reduce the chance of erroneous entry. There are other keyboard styles which are usually found on older models of microcomputers. One style uses keys similar to those found on a hand-held calculator with another style using a flat membrane type of keyboard. The membrane or calculator style keyboards are not recommended.

A numeric keypad is another feature which merits consideration. The numeric keypad is arranged like a calculator keypad and is convenient to use when substantial numerical data entry is required. Some microcomputers have a numeric keypad incorporated in their keyboard; numeric keypad attachments are available as options for most microcomputers.

OTHER INPUT DEVICES

A number of other input devices are also available. These include game paddles, joysticks, graphics tablets, and speech recognition devices. While these are not required to teach the minimum competencies, some of these devices may be used to help explain the capabilities of the computer, and some may be required with certain software, e.g., special graphics packages.

MASS STORAGE DEVICES

Mass storage devices are used to store and retrieve programs and data files, whether they are commercially prepared or student developed. Cassette tape recorders and floppy and hard-disk drives are mass storage devices. Some form of mass storage device is essential.

The cassette-based microcomputer can be purchased as a low-cost entry into instructional computing. This configuration, however, should be viewed as a "beginner unit" until experience suggests another, more appropriate configuration for educational objectives, or until additional funds are available for upgrading equipment.

The floppy-disk system is recommended over the cassette tape system for several reasons:

- The disk system offers superior access speed, accuracy and volume of storage.

- The disk-based equipment can most adequately meet the needs for computer literacy, CAI, CMI, and computer science.

- Most of the desirable courseware is in floppy-disk form.

The hard-disk system is considerably more expensive than the floppy-disk system; however, the hard-disk provides much larger storage capacity and access speed. This type of system is generally used in networking arrangements, where the storage of a large amount of software is required.

VIDEO DISPLAY

While some form of video display is necessary, several options are available and thought must be given to selecting suitable equipment. The first step is to decide whether to use a TV receiver or a video monitor.

A standard TV set can be used with most microcomputers, but a RF modulator (for radio frequency) is required. Some computers have built-in modulators or provide them as standard equipment; with others, a modulator would have to be purchased separately. Generally, a TV receiver does not provide the same quality computer display as does a video monitor. The only arguments for the use of TV receivers are that they may already be on hand, and they may be somewhat less expensive than monitors.

The true video monitor provides superior display and is preferable to the television receiver. In the selection of a monitor, several factors must be considered:

1. Screen Size - For individual microcomputer workstations a 12" (diagonal measure) screen is recommended; screens larger than 15" should be avoided. A 9" or 10" monitor may be acceptable for most CAI and programming uses, but problems are encountered with reading text, especially with 80 column wordprocessing and spreadsheet programs.

2. Color vs. Monochrome - This choice should be determined by educational objectives and the software to be used. Color may be preferable with graphics, simulations, and certain other software, especially CAI courseware. In certain applications, such as a word processor that uses the graphics mode to generate textual characters, a color monitor is actually undesirable.

3. Color Phosphor vs. Black & White - Monitors can be purchased with either a black and white display or with a single color, e.g., green or amber, on a black background. These color phosphor monitors -- called simply green-screen or amber-screen -- are preferable to black and white for reducing eye fatigue. For text-processing applications and for most programming, except graphics, green-screen or amber-screen monitors are recommended.

4. Composite Video vs. RGB - Color monitors are engineered for either composite video or RGB inputs, RGB monitors produce sharper color images,

but they are significantly more expensive. For virtually all applications, a composite video color monitor is adequate. However, some computers may have only RGB output; in these cases, the more expensive RGB monitor or additional equipment would be required.

SOUND

Like color, sound or music capability enhances certain applications and is unnecessary for others. Computers vary in the quality of sound and music they produce. Sound may help focus a user's attention on the video display or alert the user to a particular operation, including errors. It may also be used for motivation or simulation purposes, and is especially effective for use in elementary schools and in applications for exceptional children. The quality of tone and pitch becomes an important consideration when microcomputers are used in music, foreign language, or language arts classes.

While TV receivers have speakers, many monitors do not; with such monitors, external speakers would be required. Some microcomputers have small speakers built into the main body of the computer itself. In any case, a switch, independent of software, that will allow the sound to be turned off is a good option to consider.

Another optional sound device is a voice synthesizer. While not necessary for computer literacy instruction, this is another peripheral device which may expand the student's understanding of the capabilities of the computer, and which may have a practical advantage with nonreaders and visually handicapped students.

PRINTERS

The need for a printer and the type of printer selected depend upon the intended use of the computer. Many drill and practice applications, enrichment exercises, and tutorials do not require a printer. However, programming, business education applications, the generation of instructional materials, and other specialized activities do require the availability of a printer. In a computer laboratory setting, at least one printer is recommended and, depending on the work load, additional printers may be necessary.

Several types of printers are available.

1. Thermal - Thermal printers use a specially treated paper which, when struck by a heated wire mechanism, produces a visible image. Thermal printers are usually the least expensive initially, but because they require treated paper, they may be more costly in the long run. Thermal printers almost exclusively use the dot-matrix style characters and, in general, produce the poorest quality print.

2. Daisy-Wheel - Daisy-wheel printers use the paper-striking printing mechanism found on most modern electronic typewriters. As such, they produce a high quality, fully formed character and are often referred to as "letter quality." This type of printer is usually the slowest of the popular printers, while being among the more expensive. Daisy-wheel printers are not capable of handling graphic print-outs and, except when true "letter

quality" copies are required, they are not recommended as the sole printer available in the school computer lab.

3. Dot-Matrix - Dot-matrix printers are the most cost-effective printers, and the type most commonly found in schools. They use a system of pins, which strike the paper through a ribbon to produce a character formed by a pattern of dots. It is this type of printer that produces the familiar "computer-style" print. Dot-matrix printers vary in capabilities, speed, and cost; but models, which are capable of handling virtually all of the needs of the school, are available at reasonable cost. For most general purpose applications the dot-matrix printer is recommended.

Usually printers are not sold with interfacing circuit boards and cables included; these must be purchased separately and are designed for the specific computers on which they will be used. Other factors to consider when selecting a printer are paper feed, printer width, speed, noise, graphics capabilities, and other special features.

COMPUTER FURNITURE

Although standard classroom tables and table style desks can be used for classroom computers, consideration should be given to the purchase of computer workstation desks. These desks are designed to accommodate the computer and the usual peripherals, and they place the computer at the most desirable height. However, this equipment is not required and their advantages must be weighed against their cost.

PLACEMENT OF HARDWARE

The principal concern regarding the number of and the placement of computers in a school should be accessibility or, more specifically, accessibility which will provide sufficient "hands-on" experience for the number of students who need to be served in the time available in the instructional program. The number of microcomputers in a school is important; but, where the units are located and how their use is scheduled has a major impact on their accessibility.

NUMBER OF COMPUTER STATIONS

The number of workstations needed to support a particular program is influenced by several factors, e.g., the number of students to be served, the goals of the curriculum, the amount of time provided for instruction, and the other uses anticipated for the workstations. Furthermore, these factors do not function independently of one another; the decision regarding the number of computers needed in a school must take this fact into consideration.

While no formula exists which will yield a precise answer, the impact of these factors on the number of computers needed in a school can be summarized with the following observations:

- The larger the number of students to be served, the greater the number of computers needed. Especially important is the maximum number of students scheduled into a typical instructional period.

- The more the curriculum emphasizes hands-on activities, e.g., programming, word processing, and CAI, the more computer time a student needs; therefore, the greater the number of workstations required to serve a given student population.

- The shorter the time alloted to the instructional activity (both in number of periods and in length of each period), the greater the number of computers needed to deliver a given curriculum to a given population. However, if a short instructional unit is used and the school organization can accommodate the scheduling of numerous unit cycles with fewer students in each, fewer computers will be needed.

- The more the school intends to utilize computers for multiple applications, e.g., CAI, computer literacy and programming, the greater the number of computers needed.

Despite the lack of an exact formula, the experiences of a number of schools indicate that two numerical ratios are useful in determining the number of computer workstations which should enable the school to operate successfully: in terms of the total student population in a school, one computer for each 30 to 50 students appears appropriate to meet most needs; and, for a given instructional period, two students per workstation is recommended, with three per station being acceptable.

LOCATION OF COMPUTER STATIONS

Along with the decision concerning the number of computers to purchase are decisions which relate to the location and scheduling of the computers so that classes, and individual students and teachers, will have access to them. It should be noted that the mode of placement of the computers, in turn, influences the number of machines needed. With some variations, there are basically three modes of placement:

- A lab-based approach.

- A classroom-based approach.

- A combination of the two.

Lab-Based Approach

In the lab-based approach, computers are placed in a central location in the school and classes and individuals are scheduled into the lab. Computer labs are located typically in classrooms dedicated to such use, but they also are found in media centers, mobile units, and even modified school buses.

In secondary schools, where the organizational patterns already involve the regular movement of students from class-to-class, the lab-based approach is widely employed.

In general, a lab-type setting permits the maximum access for the number of computers available, although, it may do so at the expense of some flexibility. In considering the computer lab approach, the following points are important:

- The lab avoids crowding in classrooms.
- The lab requires a space for its installation.
- The lab is efficent because the computers are always ready for use.
- The lab permits the use of computer networks, which, while they are themselves an expense, may offer certain cost reductions.
- The lab provides for better security and may reduce maintenance because of better supervision and less movement of units.

In most schools using the lab-based approach, computers are purchased and installed for exclusive use by that school and in that lab. In some divisions, a set of computer workstations is rotated among several schools. For example, 16 workstations may be brought into a particular school for a specified period of time, perhaps six weeks. The school then teaches its computer literacy unit during that time. Afterwards, the computers are moved to another school, and the cycle is repeated. This latter approach reduces the total number of microcomputers needed strictly for teaching computer literacy within the division, but careful coordination of computer movement is required. Also, this approach may reduce flexibility and diminish the other uses of computers in each school.

Classroom-Based Approach

Using this approach, microcomputers are placed in individual classrooms rather than concentrated in a central location. In some instances one or more computers are permanently assigned to particular classrooms; in others, a pool of microcomputers is maintained, usually in the school media center. Units are checked out on a day-to-day basis to teachers in the same manner as audiovisual equipment. Typically, permanent assignment of a computer is only made to the classrooms in which there will be ongoing educational applications unless, of course, there are enough computers available to assign one or more to each room in the school. A check-out system is used when relatively few computers are available and when the computers will be used primarily to aid general instruction. The classroom-based approach is used more frequently in elementary schools than in secondary schools.

In considering the classroom-based approach, the following points must be weighed for their relative advantages or disadvantages:

- This approach makes use of existing classroom space and does not require restricting a room for use only as a lab.
- Students do not have to be moved to the lab.

- Fewer students can receive "hands-on" computer time in a given period.

- In the case of permanent assignment, the computer is always immediately available whenever a need presents itself.

- With a check-out system, scarce computer resources can be utilized more efficiently. A microcomputer does not have to sit idle when a particular teacher does not need it.

- A check-out system will require mobile furniture or carts and may be difficult in multi-level buildings.

- Classroom-basing may cause overcrowding in the room.

Combination Approach

With this approach a school usually establishes a centralized computer lab; additionally, it has a number of microcomputers available for check-out to individual classrooms. This approach may require the purchase of a larger number of computers, but it merges the advantages of both systems of placement while reducing most of the disadvantages of each. The combination approach most likely permits the widest range of instructional utilization of computers.

SELECTING SOFTWARE

Microcomputer software must be selected carefully if it is to be an effective instructional and administrative tool in the school. Toward this end, each school division should develop its own policy for selecting computer software. The policy, which should govern all purchases of software, should include a needs-assessment procedure as well as criteria and procedures for review and evaluation.

NEEDS ASSESSMENT

In selecting computer software, present and future curriculum needs should be examined and should include:

- Subject matter CAI needs
- Applications indicated by various instructional strategies, and
- Instructional and administrative information management policies and procedures.

From the needs assessments, strategies can be developed for using computers to enhance learning and school management; short and long-range software needs can be defined, and priorities for acquisition can be established.

Needs assessment should be an on-going process, involving teachers in all grades and in all disciplines. Software needs and priorities should be reviewed and revised at regular intervals.

CRITERIA

Each school division must determine its own criteria for software selection. It may borrow from standard guidelines, such as those stated below, but only the locality can determine which features, and what standard of quality are most important in meeting their needs and most consistent with their policies and procedures.

Local Criteria

School divisions will differ in their policies and procedures for selecting computer software, and in the hardware configurations and delivery models used in their schools. Software selection criteria such as the following relate to these local differences:

- Previewing
- Networking agreements
- Back-up copies, and
- Returns.

For example, if the school uses a microcomputer lab networking system, then software used would have to be compatible with that network; on the other hand, if no lab networks are used, this criterion is unimportant.

General Criteria

Certain criteria should be considered regardless of subject area, grade level, intended use and program quality. These criteria focus on the extent to which the software...

1) takes advantage of the capabilities of the microcomputer.

   - Does it employ graphics and animation?
   - Does it randomize problems and examples?
   - How much interactivity is provided?
   - Does it branch to higher or lower levels of difficulty based on student performance?
   - Does it provide feedback and record keeping?

2) facilitates interaction between the user and the program.

   - Are on-screen prompts and instructions clear?
   - Is the input of responses or controls consistent and uncomplicated?

3) adheres to sound principles of instruction.

   - Does it provide appropriate motivation and presentation?
   - Is there sufficient opportunity for practice?
   - Does it give satisfactory information about results?

4) provides adequate documentation.

   - Is there a full description of the program features and capabilities?
   - Are there clear and detailed instructions for operation and possible modifications?
   - Are objectives stated, and are target students identified?
   - Are instructional guidelines included?

Specific Criteria

Other evaluation criteria relate to the more detailed characteristics of program design, production, and presentation. Standards for some of these criteria may vary according to the subject, application, and grade level for which the software is being selected. These criteria focus on the following characteristics:

1. The mode of instruction.

   - Do tutorial programs present basic instruction in clear sequential steps?

   - Do drill and practice programs reinforce skills or concepts previously taught, and do they provide an explanation of the content being drilled if the student does not give a correct response in a specified number of attempts? Is the program sufficiently interactive to keep the students working at an appropriate level of difficulty?

   - Do simulations accurately reflect a vital aspect of real-life situations or processes, and make the experience meaningful by requiring student involvement such as analyzing, making judgements, and solving problems?

   - Do problem-solving programs go beyond simple or typical word problems to allow "what if" analyses by students, in which they can alter various factors of the problem or supply varying data and observe their effect on the outcome?

   - Do educational games stress instructional value over the game format, correlating skill level to the complexity of the game? Are they fun to play?

2. The content of the program.

   - Is the scope of the content comprehensive, but presented in manageable segments?

   - Is the content appropriate, does it relate to the school curriculum, and does it involve the use of concepts and examples which are relevant to the student's experience?

   - Is the content accurate, and does it involve correct grammar, spelling, and sentence structure?

3. The design of the program.

   - Is the program easy to use, does it incorporate instructions into the screen display and does it require only responses which are appropriate for the grade level of the students? Is the program consistent in the procedures students must use to input data or responses?

   - Can the pace of the program be controlled by the student? Or, if timed, is it appropriate to the maturity, experience, and capabilities of the intended students? Can it be adjusted by the teacher?

- Is it clear, presenting instructions and information in understandable, concise terms?

- Is it "personalized," referring to the student by name and providing positive reinforcement or encouragement and reassurance without being patronizing?

4. The production and presentation of the program.

   - Does the overall visual display use images and characters of appropriate size and clarity for the maturity, experience, and ability of the intended students?

   - Are graphics used to clarify and enhance understanding of the content rather than being just "decorative"?

   - Is sound used to enhance understanding of content, to reinforce student response, or to call attention to errors in input procedures? Can sound be controlled by the student or teacher?

5. The instructional management capabilities of the program.

   - Does the program monitor performance in terms of correct and incorrect responses, number of attempts, and time of response for individual students? For an entire class?

   - Does the program provide diagnostic analyses of students' abilities and determine the appropriate level of instruction?

   - Can the teacher alter or designate the difficulty level of the program? If so, can the level be designated for individual students?

SELECTION PROCESS

The process leading to the purchase of software consists of several fairly distinct phases. The selection of software is more reliable when based upon actual preview and evaluation but this step should be preceded by the identification and review of potentially useful software.

Identify Available Software

Potentially useful software is generally identified by searching publishers' and vendors' catalogs, or through the use of software directories such as TESS, The Educational Software Selector, published by EPIE. Advertisements in journals and periodicals and the recommendations of other educators are also useful. The software objectives stated in these sources should be compared to the curricular needs of the school. This comparison will produce a list of potential software.

Preliminary Evaluation

The next step is a review to reduce the list of software to the packages most likely to meet local needs. In making this preliminary review, educators most frequently rely on secondary sources of information. Among these are software evaluation services such as EPIE and MicroSIFT, and reviews published in professional journals. Perhaps the most valuable sources of information are other schools which are already using the program.

As discussed in an earlier chapter, software evaluations from MicroSIFT and school divisions within the state are available through VNET, the department's online information service. Evaluations from EPIE and MicroSIFT, as well as other print services, are available in the Technology Examination Center in the Department of Education. Because the quality of evaluations varies, and because different reviewers may reach different conclusions, the most reliable practice is to compare evaluations from several sources.

Purchases based solely on evaluations from secondary sources should be avoided; a hands-on examination is essential. Using the information in the reviews, a list of programs which appear to meet local needs can be compiled. Copies of the programs may be requested for preview from vendors or publishers.

Review and Evaluation

Preview policies vary among software suppliers. Some suppliers will loan packages to schools for a specified time for preview before purchase; others require purchase, but will permit the return of the product if it is not suitable; still others require purchase without recourse; in fact, some will not even guarantee that their software will work! If programs being considered cannot be obtained for preview elsewhere, educators might consult the Technology Examination Center in the Department of Education. If the program is among the TEC's software holdings, it could be previewed there.

Having obtained a preview copy of the software being considered for purchase, the educator is ready to conduct an authoritative review based upon the local evaluation criteria. The reviewer should run the program several times, concentrating on a different aspect of the evaluation with each cycle. It is important that the reviewer examine each of the options and branches of the program. This, too, will require running the program several times.

When reviewing software, the use of an evaluation instrument is recommended. Evaluation instruments are available from a variety of sources. It is important that the evaluation instrument reflect the criteria to be used for evaluation, and include some type of rating scale and a place for the comments of the reviewer. Such an instrument will guide the educator to consider each of the criteria. It will also serve as a permanent record of the evaluation for future reference. Finally, based on the evaluations, the decision is made whether or not to purchase the material.

Summarizing, the main steps in the software selection process are: defining needs, identifying available software, evaluating software, and selecting the most appropriate software for purchase.

STAFF DEVELOPMENT IN EDUCATIONAL COMPUTING

The advent of the microprocessor and the subsequent influx of microcomputers into the school setting are such recent phenomena that the overwhelming majority of educators lack any pre-service computer education. Therefore, the implications of the computer revolution for in-service education are staggering. To assist school divisions in coping with this enormous staff development challenge, the Division of Instructional Media and Technology convened a task force on microcomputer in-service training in the spring of 1983. The task force was composed of representatives of higher education, representatives of local school divisions and members of the division utilization staff.

The purposes of the task force were:

- To identify statewide in-service objectives.
- To recommend priorities for the Department of Education in providing in-service training to localities.
- To develop a flexible model to be used by school divisions and higher education in providing in-service training for teachers and other school personnel in instructional computing.

The guidelines and suggestions which follow should be an aid to educators planning staff development programs, regardless of the size or the degree of technical sophistication of the school division. Their use should produce a comprehensive and balanced in-service training effort which will assist teachers to learn about computers, use computers to teach, and teach students to use computers.

Since educators have varying aptitudes, interests, and abilities, the degree to which they can and will be prepared in these three areas will vary. Therefore, three levels of competency have been proposed:

Level I - Basic Literacy

Level II - Utilization in Instruction

Level III - Specialization

LEVEL I - BASIC LITERACY

The "basic literacy" level of competency involves minimum exposure to the uses of microcomputers in a school setting. The proposed in-service training would consist of 16 hours of classroom instruction with as much "hands-on" experience as possible. A complete description of a suggested course is contained in the section on "basic literacy." The Department of Education recommends that all educators in Virginia (particularly those who will be teaching computer literacy as defined in "Computer Literacy for Students in Virginia," Virginia Department of Education, 1983) achieve this level of competency by 1986.

LEVEL II - UTILIZATION IN INSTRUCTION

The "utilization in instruction" level of competency is for educators who will be using computers as instructional and management tools. At this level of competency, educators should acquire a "journeyman's level" of knowledge and skill. Educators planning to use computers to assist with instruction should receive a minimum of 45 hours of instruction or have the equivalent in experience and study. Training should concentrate on utilizing computers for instruction; evaluating software; and problem solving with computers through BASIC, LOGO, or some other appropriate introductory programming language. Other topics to be covered are outlined in Level II-"Utilization in Instruction." The Department of Education recommends that all educators needing Level II Competencies achieve them by 1988.

LEVEL III - SPECIALIZATION

The "specialization" level of competency is for teachers who want special purpose training. Educators would not be expected to become skilled in all areas of instructional computing; instead they would acquire the knowledge and skills necessary to serve as resource persons. Specializations might include programming languages; developing and/or using instructional software; developing database systems; and planning, delivering, and evaluating a computer literacy course, or computer managed instruction. A complete description of these specialities may be found in Level III "Specialization." The Department of Education recommends that by 1988 between 5 and 10 per cent of the educators in Virginia should be qualified in at least one area of specialization and could thereby serve as resource persons for a school division or group of school divisions.

LEVEL I - BASIC LITERACY

Rationale: Training at this level should prepare certain educators to teach those competencies defined in "Computer Literacy for Students in Virginia" (VDOE, 1983) and supported by "Standards for Accrediting Schools in Virginia" (VDOE, 1983). Furthermore, this level of training would allow all educators to develop a basic understanding of computer technology as it relates to education and society.

Goal: The overall goal for this level of competency is to provide instruction to assist the educator in:

- Acquiring the knowledge and skills necessary to plan and deliver a program of computer literacy instruction as defined in "Computer Literacy for Students in Virginia";
- Developing an understanding of computers, especially the microcomputer; and,
- Developing skills to operate and use microcomputers.

Target Population:

This is recommended for all educators who will teach computer literacy and for those who need to develop minimum competencies in operating and

understanding microcomputers. This training represents the minimum preparation required to teach computer literacy as defined in "Computer Literacy for Students in Virginia." School divisions requiring a more comprehensive unit or course in computer literacy may require additional preparation as recommended in Level III, Objectives 3 and 15.

Delivery Strategies:

The course content and amount of in-service hours needed to achieve the goals listed above could include 1 credit/16 hour non-college credit or 1 college credit hour (15 hours).

LEVEL I OBJECTIVES

Objective 1

The educator will define selected computer terminology.

This should include:

a. Hardware components, e.g., CPU, disk drive, monitor, keyboard;
b. Functions, e.g., input, processing, output, and,
c. Procedures, e.g., load, list, catalog, save, run.

Objective 2

The educator will identify the basic components of a computer and describe the function of each.

This should include:

a. Central processing unit;
b. Types of memory; and,
c. Input/output devices.

Objective 3

The educator will load and run selected software.

This should include:

a. Setting up and turning on the computer;
b. Loading the cassette tape or disk; and,
c. Issuing commands necessary to run selected software.

Objective 4

The educator will interact with the computer using keyboarding skills.

This should include:

a. Alphanumeric keys;
b. Special function keys, e.g., Break, Control, Return (Enter), CTRL, Reset; and,
c. Numeric key pads.

Objective 5

The educator will select and use an appropriate program to accomplish a given task.

This should include:

a. Analyzing the task;
b. Selecting appropriate software; and,
c. Using program documentation to implement software.

Objective 6

The educator will describe a computer program.

This should include:

a. Explaining the sequential statements;
b. Explaining program commands, e.g., input, print; and,
c. Explaining the logical design.

Objective 7

The educator will be given a problem which will require the writing of a simple program.

This should include:

a. Defining the logical solutions to the problem;
b. Coding the problem in a programming language;
c. Testing the program;
d. Debugging the program; and,
e. Documenting the program.

Objective 8

The educator will describe the impact of computers on society.

This should include:

a. Computer applications in the home;
b. Computer applications in the educational environment; and,
c. Computer applications in business, industry, and government.

Objective 9

The educator will describe the potential and limitations of the computer with emphasis on its use as an instructional tool.

This should include:

a. Identifying the broad categories of computer use, e.g., computers as an object of instruction and as an instructional tool;
b. Identifying specific instructional strategies, e.g., drill and practice, simulation, tutorial;
c. Exploring the advantages and disadvantages of using the computer to perform certain tasks; and,
d. Understanding the current and possible future capabilities of computers.

Objective 10

The educator will identify ethical, social, and economic issues relating to the use of computers.

This should include:

a. Current trends and issues in copyright laws;
b. Current trends and issues in equity;
c. Current trends and issues in budgeting; and,
d. Current trends and issues in privacy.

Objective 11

The educator will recognize the value of computer skills for future education and employment.

This should include:

a. Exploring computer-related careers; and,
b. Identifying prerequisite skills to aid students in making career decisions.

Objective 12

The educator will describe electronic databases as information sources.

This should include:

a. Identifying the types of information found in databases; and,
b. Identifying available database systems.

Objective 13

The educator will recognize the need for using evaluative criteria to select software.

This should include:

a. Matching software with instructional goals and objectives; and,
b. Examining software for appropriateness of content and format using an evaluative instrument.

LEVEL II - UTILIZATION IN INSTRUCTION

Rationale: Training at this level should prepare educators to use computers as instructional and management tools. Whereas Level I training provides an information base and minimal skill development, Level II training should enable teachers to incorporate the use of computers into their instructional planning. Level II should provide the necessary knowledge and skills to design unit/lesson plans, evaluate and select appropriate materials, plan effective utilization strategies, and evaluate the results of computer activities.

Goal: The overall goal for this level of competency is to provide instruction to assist the educator in:

- Using computers effectively in teaching specific subject matter content; and,
- Using microcomputers as classroom management aid.

Target Population:

Level II training should be the minimum attained by the following groups of educators:

- Teachers who use (or plan to use) computers to assist in teaching specific content or manage instruction; and,
- Supervisors/administrators involved with decision-making as it affects the instructional potential of computing or personnel involved in instructional computing.

Level I training is not a prerequisite for Level II training.

Delivery Strategies:

The course content and amount of in-service hours needed for educators to achieve the goals listed above should be based on the needs of each school and may vary from school to school. However, it is recommended that most educators should complete 45 hours of training, or a three-semester hour college credit course or the equivalent in experience and study. In general, at least 50% of the course content should be directed toward the use of the computer as a teaching and management tool. Substantial "hands-on" experience must be provided during the in-service training. No more than 25% of the time should be allocated for the teaching of programming skills, since most teachers do not need to be programmers. Teachers, however, should understand the fundamentals involved in the process of programming in order to appreciate the potential and the limitations of computers.

LEVEL II OBJECTIVES

Objective 1

The educator will choose the computer as a teaching tool when it improves or enhances instruction.

This should include:

a. Understanding the function of:
   - Drill and Practice CAI
   - Tutorial CAI
   - Simulation CAI
   - Instructional Gaming
   - Problem Solving CAI
   - Word Processing;

b. Recognizing when the computer is an appropriate teaching tool for an instructional unit;
c. Determining usage based on the individual and developmental needs of students; and,
d. Identifying available resources for software selection.

Objective 2

The educator will use evaluative criteria to select software which matches goals and objectives.

This should include:
a. Using software review instruments, e.g., "MicroSIFT", "EPIE"; and,
b. Selecting software consistent with local curriculum objectives.

Objective 3

The teacher will select software that is technically compatible with hardware.

This should include:
a. Recognizing RAM memory requirements;
b. Recognizing necessary hardware requirements; and,
c. Recognizing necessary language requirements.

Obective 4

The teacher will design lesson plans which effectively integrate the computer into an instructional unit.

This should include:
a. Aligning selected software with instructional objectives; and,
b. Developing utilization strategies appropriate for class size and resource availability.

Objective 5

The educator will use selected software to achieve curriculum objectives.

This should include:
a. Organization and management of instructional applications;
b. Use of the computer as a motivational strategy;
c. Strategies for scheduling students to improve time-on-task; and,
d. Maintenance of software and hardware, e.g., cleaning, protection of elements susceptible to damage.

Objective 6

The educator will evaluate the effectiveness of computer utilization in the classroom.

This should include:

a. Formative evaluation; and,
b. Summative evaluation.

Objective 7

The educator will be able to select, evaluate, and use software for classroom management.

This should include:

a. Computer-managed instruction;
b. Database management;
c. Word processing;
d. Electronic spreadsheets;
e. Teacher utilities; and,
f. Testing and evaluation programs.

Objective 8

The educator will define or identify computer components and terminology.

This should include:

a. Computer components;
b. Peripheral devices; and,
c. Other computer terminology.

Objective 9

The educator will explain the recent developments in computer technology and their applications in daily living.

This should include:

a. Brief history of computers, e.g., ENIAC, the transistor, the chip, the microprocessor;
b. Uses of computers, e.g., entertainment, word processing, data management, shopping and banking by computer, electronic mail;
c. The potential and limitations of the computer, e.g., when its use is not appropriate, capabilities of different sizes of computers; and,
d. The types and purposes of electronic databases as information sources.

Objective 10

The educator will write and execute introductory level computer programs.

This should include:

a. An understanding that a program is a series of logical, sequential statements which instruct the computer to perform the operations necessary to solve a problem or complete a task; and,
b. An introduction to a programming language such as BASIC or LOGO (BASIC language programming skills, if used, should be limited to variables and operations, input/output statements, decisions, looping, and possibly the use of simple flowcharts).

LEVEL III - SPECIALIZATION

Rationale: Some educators may want to develop specialized skills in a certain area of educational computing. Such skills would allow these individuals to assume leadership and resource roles in a school system. An educator is not expected to achieve advanced proficiency in all of the competencies.

Goal: The overall goal for this level of competency is to provide increased specialization in order to accomplish one or more of the following objectives:

- Integrate computers into specific content areas;
- Introduce CAI and CMI into a school system;
- Supervise and coordinate software collections;
- Develop software programs;
- Teach computer programming courses;
- Coordinate hardware, peripherals, etc.;
- Supervise maintenance of hardware;
- Direct research in educational computing;
- Represent computer interests with students, teachers, administrators, parents, school board officials, and the public; and,
- Teach computer literacy courses.

Target Population:

Individual competencies listed at this level may be needed by one or more persons or a team of persons such as classroom teachers, library media specialists, supervisors and/or administrators.

Delivery Strategies:

Because of the sophistication of Level III skills, more advanced training would require access to specialized hardware, a wide range of software packages, and content experts. Potential delivery systems are college credit courses, professional association workshops, training sessions conducted by equipment manufacturers or consultants, and self-instructional materials.

LEVEL III OBJECTIVES

Objective 1

The educator will identify, evaluate, and recommend available instructional software in specific content areas.

This should include:

a. Coordination of resources and curricular objectives;
b. Identification of review sources;
c. Location of software sources; and,
d. Evaluation of software.

Objective 2

The educator will design and develop instructional courseware.

This should include:

a. Instructional design of educational curriculum;
b. Design of instructional courseware; and,
c. Use of authoring systems.

Objective 3

The educator will code educationally usable programs.

This should include:

a. Programming proficiency in various languages, e.g., PASCAL, BASIC, PILOT;
b. Development of accompanying support materials; and,
c. Adaptation or modification of previously prepared programs.

Objective 4

The educator will select and use the appropriate utility programs to solve given problems.

This should include:

a. Identification of available utility programs;
b. Use of diagnostic software;
c. Use of test generators;
d. Use of graphic utilities; and,
e. Use of database systems.

Objective 5

The educator will describe and apply recent developments in computer technology.

This should include:

a. Expertise in computer-assisted design and computer-assisted manufacturing; and,
b. Expertise with voice recognition and speech synthesis equipment.

Objective 6

The educator will utilize appropriate remote databases.

This should include:

a. Identification and selection of sources; and,
b. Economical use of different database sources.

Objective 7

The educator will manage software packages.

This should include:

a. Acquisition policies for software;
b. Processing (licensing and back-up) of software;
c. Cataloging of software;
d. Storage of software; and,
e. Distribution of software.

Objective 8

The educator will implement computer-managed instruction in a specific content area.

This should include:

a. Evaluation of subject matter instructional options;
b. Application of appropriate CMI strategies; and,
c. Implementation of techniques for a classroom, school, or system.

Objective 9

The educator will be able to evaluate effects of computer-related instruction.

This should include:

a. Analysis of cognitive, affective and psychomotor performance;
b. Selection of appropriate evaluation strategies;
c. Application of valid measurement techniques; and,
d. Identification or construction of valid evaluation instruments.

Objective 10

The educator will use appropriate criteria to select hardware which matches curricular goals and objectives.

This should include:

a. Knowledge of computer hardware characteristics;
b. Location of information on hardware innovations; and,
c. Application of system analysis techniques.

Objective 11

The educator will specify and set up the components of specialized computer systems.

This should include:

a. Selection and supervision of a microcomputer network system;
b. Knowledge of interfacing peripherals with a microcomputer, e.g., modem, printer; and,
c. Utilization of hardware for unique problems, e.g., Special Education.

Objective 12

The educator will identify and implement the interfacing of microcomputers with other technologies.

This should include:

a. Use of interactive video-tape;
b. Use of interactive video-disc;
c. Use of interactive video via cable TV; and,
d. Use of analog laboratory instruments.

Objective 13

The educator will diagnose and prescribe appropriate hardware maintenance.

This should include:

a. Application of hardware disgnostic programs, e.g., motherboard chips, disk drives, CRT;
b. Calibration and adjustment of hardware components; and,
c. Repair of simple hardware problems.

Objective 14

The educator will analyze the potential legal, ethical, social, psychological, and economic issues resulting from a high technology society.

This should include:

a. Evaluation of present and future computer-related changes, e.g., robotics, computer crime, invasion of privacy, employment patterns, equality of access.

Objective 15

The educator will be able to plan, deliver, and evaluate a computer literacy course.

This should include:

a. Instructional design of a computer literacy curriculum;
b. Identification and/or development of instructional materials;
c. Organization and management of instructional activities; and,
d. Evaluation of student achievement.

RESOURCES FOR STAFF DEVELOPMENT

To assist school divisions in implementing in-service training programs in computer literacy, the Division of Instructional Media and Technology has acquired a variety of staff development materials including videotapes, multi-media kits, microcomputer software, and print materials. As described in an earlier chapter, these materials are maintained in the Technology Examination Center for previewing by school personnel. Most of these materials may not be removed from the TEC.

On and About Instruction...Microcomputers

This is a series of 16, 30-minute videotapes and related print materials based on the Level I-Basic Literacy objectives. The series is produced by the Division of Instructional Media and Technology and serves as the basis for a one unit, non-college credit, in-service course. The programs present basic information and demonstrations pertaining to the Level I objectives. The print materials provide descriptions of each program and outline learning activities which constitute a minimum 30-minute follow-up to each program.

Program #1 IMPACT OF COMPUTERS ON SOCIETY (Objective #8)

Discusses the kind of society for which we must educate our students based on computer applications in the home, educational environment, business, industry and government.

Program #2 COMPUTER SKILLS FOR EDUCATION AND EMPLOYMENT (Objective #11)

Discusses computer skills needed for careers in both high tech and low tech environments and predicts percentages of employees that will be found in each category.

Program #3 COMPUTER COMPONENTS AND TERMINOLOGY (Objectives #1 & 2)

Explains various computer terms regarding hardware, software, functions and procedures and, in addition, identifies the major components of a computer.

Program #4 RUNNING SOFTWARE AND KEYBOARDING SKILLS (Objectives #3 & 4)

Demonstrates setting up the computer and loading/running packaged software on various brands and configurations of microcomputers in addition to discussing keyboarding.

Program #5 WORD PROCESSING (Objectives #5 & 9)

Demonstrates word processing and discusses its successful application to educational problems.

Program #6 ELECTRONIC SPREADSHEETS AND GRAPHING TOOLS (Objectives #5 & 9)

Demonstrates electronic spreadsheets and graphing tools, suggesting their successful application to educational problems.

Program #7 DATABASE MANAGEMENT (Objectives #5 & 9)

Demonstrates setting up and maintaining electronic databases on microcomputers and discusses their successful application to educational problems.

Program #8 COMPUTER-ASSISTED INSTRUCTION #1 (Objectives #5 & 9)

Discusses Drill and Practice and Tutorial type CAI (Computer-Assisted Instruction) programs in detail, presenting their most effective application to the educational setting.

Program #9 COMPUTER-ASSISTED INSTRUCTION #2 (Objectives #5 & 9)

Discusses Educational Gaming and Simulation type CAI programs in detail, presenting their most effective application to the educational setting.

Program # 10 COMPUTER-MANAGED INSTRUCTION (Objectives #5 & 9)

Presents the following six facets of Computer-Managed Instruction (CMI):

1. Diagnosis and prescription
2. Record keeping and reporting
3. Evaluation and testing
4. Monitoring student progress
5. Attendance, grading and scheduling
6. Generating curriculum materials

Program #11 SOFTWARE EVALUATION #1 (Objective #13)

Demonstrates the necessity of evaluating software based on specific objectives and outlines procedures for the evaluation process.

Program #12 SOFTWARE EVALUATION #2 (Objective # 13)

Looks at and demonstrates specific characteristics that should be examined when evaluating educational software.

Program # 13 PROGRAMMING AND PROBLEM SOLVING (BASIC)
(Objectives # 6 & 7)

Discusses the concept of programming using the BASIC language as a problem solving tool.

Program # 14 PROGRAMMING AND PROBLEM SOLVING (LOGO)
(Objectives #6 & 7)

Discusses the use of the programming language LOGO as an aid to problem solving and depicts its effective application.

Program #15 ELECTRONIC DATABASES (Objective #12)

Demonstrates the accessing of electronic databases as information sources and discusses their implications for education.

Program # 16 ETHICAL, SOCIAL AND ECONOMIC ISSUES (Objective #10)

Presents ethical, social and economic issues related to computers including copyright, equity, and privacy.

Ready or Not

This is a series of eight, 30-minute programs dealing with planning for and the use of microcomputers in the schools. The series is produced by the Division of School Television, Educational Media and Technology Services, North Carolina Department of Public Instruction, in cooperation with Mississippi Educational Television. A twenty-page user's guide is available for $2.00 from Division of School Television, North Carolina Department of Public Instruction, Raleigh, NC 27611.

Program #1 PLANNING FOR MICROCOMPUTERS

Discusses considerations involved when planning to introduce microcomputers into the classroom.

Program #2 COURSEWARE REVIEW: THE CRITERIA

Examines necessary criteria for evaluating courseware content, production, and presentation.

Program # 3 COURSEWARE REVIEW: THE PROCESS

Discusses methods of applying that criteria found in the previous program.

Program #4 MANAGING MICROCOMPUTERS: THE MICROCOMPUTER GAME

Presents curricular choices and examines ways computers can be used in different settings.

Program # 5 ADMINISTRATIVE MANAGEMENT IN SCHOOLS: SOFTWARE

Discusses how to choose the best management software for your school's needs.

Program # 6 ADMINISTRATIVE MANAGEMENT IN SCHOOLS: CASE STUDIES

Demonstrates successful administrative management computer programs.

Program # 7 MICROS AND THE ARTS

Demonstrates computer courseware available in the arts.

Program # 8 MICROS AND THE WRITING PROCESS

Demonstrates the use of microcomputers to enhance and develop communications skills.

Other Computer Related Videotapes

In addition to the programs described above, a number of other programs are available from the Division of Instructional Media and Technology. These programs include series such as, "The Computer Program," "Making the Most of the Micro" and "Educational Computing Profile," as well as individual programs on a variety of topics pertaining to the use of microcomputers in the school. These videotapes are listed in Audiovisual Instructional Materials for Virginia's Public Schools, 1984.

School divisions may order copies of the videotapes described above through the Production and Dissemination Service, Division of Instructional Media and Technology, Virginia Department of Education. Copies can be made in the VHS, BETA I, and U-MATIC videocassette formats.